ASPECTS OF THE BIOLOGY OF *DIPLODUS SARGUS KOTSCHYI* (SPARIDAE) FROM KUWAIT BAY

by

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ABSTRACT. - In the period September 1987 to August 1988, hadras (stake traps) and trawls were used to capture *Diplodus sargus kotschyi* (Steindachner, 1876) from the sand and rock intertidal of Kuwait Bay. Length frequency analysis showed that recruitment of young of the year took place in March. Gonadosomatic indices revealed that spawning took place between November and March. Protandrous sex reversal took place for the majority of fish in the second year of life, a number of fish did not undergo sex reversal. *D. sargus* spent its whole life in the bay. The largest fish were markedly smaller than previously reported for the Arabian Gulf.

RÉSUMÉ. - De septembre 1987 à août 1988, des nasses (hadras) et un chalut ont été utilisés pour pêcher des *Diplodus sargus kotschyi* (Steindachner, 1876) sur le sable et les roches dans la zone de balancement des marées de la baie du Koweit. L'analyse des fréquences des longueurs montre que le recrutement des jeunes de l'année se fait en mars. La majorité des poissons change de sexe (protandrie) dans leur deuxième année mais certains n'en changent pas. *D. sargus* passe toute sa vie dans la baie. La taille des poissons échantillonnés est en moyenne plus petite que celle qui est classiquement observée dans le Golfe Arabique.

Key-words: Sparidae, *Diplodus sargus*, Kuwait Bay, Life cycle.

Diplodus sargus kotschyi (Steindachner, 1876), as described by Bauchot and Smith (1984), has been previously reported from Kuwait and the Arabian Gulf as *Diplodus sargus* (Clayton and Abou-Seedo, 1986), *Diplodus noct* (Blegvad, 1944; Kuronuma and Abe, 1972; Relyea, 1981; Dames and Moore, 1983) and *Diplodus kotschyi* (Randall *et al.*, 1978; Kuronuma and Abe, 1986). *D. noct* is considered to be endemic to the Red Sea (Bauchot and Smith, 1984) and *D. sargus kotschyi* is the only species with a black blotch on the caudal peduncle to be found in the Arabian Gulf. In the present paper the fish will be referred to as *Diplodus sargus kotschyi*.

Diplodus sargus kotschyi is considered to be the most common member of the Sparidae in the Arabian Gulf and to be the most common species of fish associated with rock substrate (Relyea, 1981). During September 1981 to September 1982 a total of 1685 *D. sargus* were captured using trawls and seines, young of the year recruited in March and spawning was considered to occur in February, although most adults were thought to migrate elsewhere (Dames and Moore, 1983). Of the 1685 fish captured, 728 came from a single seine caught in May 1982 with the majority of fish captured in shallow water in the south-eastern part of Kuwait Bay (Dames and Moore, 1983) which is dominated by sand and rock intertidal environments (Jones, 1986).

Maximum length is consistently reported as 300 mm (Kuronuma and Abe, 1972; Randall *et al.*, 1978; Relyea, 1981; Bauchot and Smith, 1984; Clayton and

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Abou-Seedo, 1986) although Dames and Moore (1983) recorded a maximum size of 173 mm.

Diplodus sargus is hermaphrodite with most fish being protandrous (Micale *et al.*, 1987) with sex reversal occurring at various ages (Atz, 1964). Studies in the Mediterranean suggest that sex reversal takes place in the third year of life or later (Micale *et al.*, 1987).

Previous work on the reproductive biology of this species has been carried out in the Mediterranean (Micale *et al.*, 1987). Kuwait Bay, in the northern Arabian Gulf, is characterised by a wide range in sea temperature (13.2-32.8°C) and a high salinity (39-46‰) (Wright, 1989). The present study uses length frequency histograms, gonadosomatic indices and age to examine, for the Arabian Gulf, the probable time of spawning, time of recruitment of young of the year, age structure of the population and to examine the probable time of sex change in this protandric species.

MATERIALS AND METHODS

Hadras (stake traps), otter trawls and beach seines were used once a month to capture *Diplodus sargus kotschyi* from an intertidal sand and rock environment at Doha, Kuwait Bay (29°,23'N 48°,50'E) (Fig. 1). The hadra was constructed of 30 mm mesh wire netting, catches were taken at low water on two successive mornings. Six trawl hauls were taken on a rising tide in the intertidal zone in a maximum depth of 2 m. Tidal range in Kuwait Bay is between 3.5 and 4 m (Jones

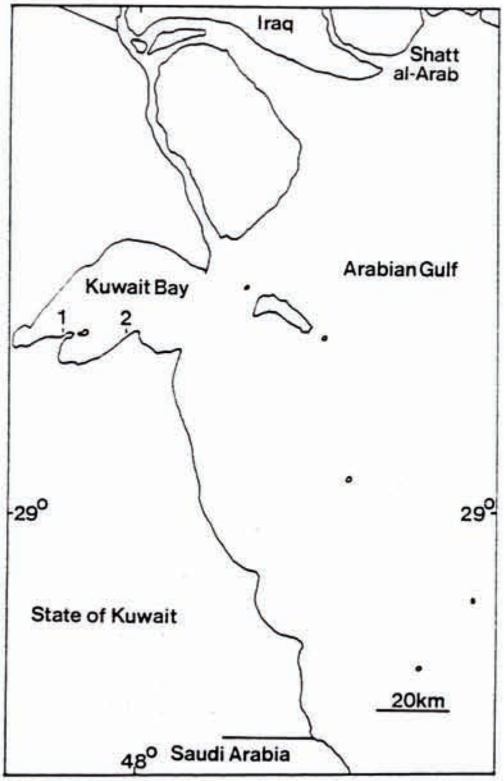

Fig. 1: Map of Kuwait bay showing location of sampling sites. 1: Doha and 2: Kuwait City.

and Clayton, 1983). The trawl had a mouth width of 4 m, constructed of 13 mm stretch mesh and with a cod end of 6.5 mm stretch mesh. Each trawl lasted for 5 minutes at a speed of 0.5 ms-1. Six beach seine hauls were taken through a distance of 15 m parallel to the shore in a maximum depth of 1.5 m. The seine was constructed of 6.5 mm stretch mesh and was 6.15 m long and 2.10 m deep. Temperature and salinity were determined on each day of sampling.

Total length and weight were measured to the nearest millimeter and milligram. Sex was determined by microscopic examination of the whole gonad and classified as unsexed for small undeveloped gonads and either male or female, depending on whether ovarian or testicular tissue dominated the gonad. Weight of

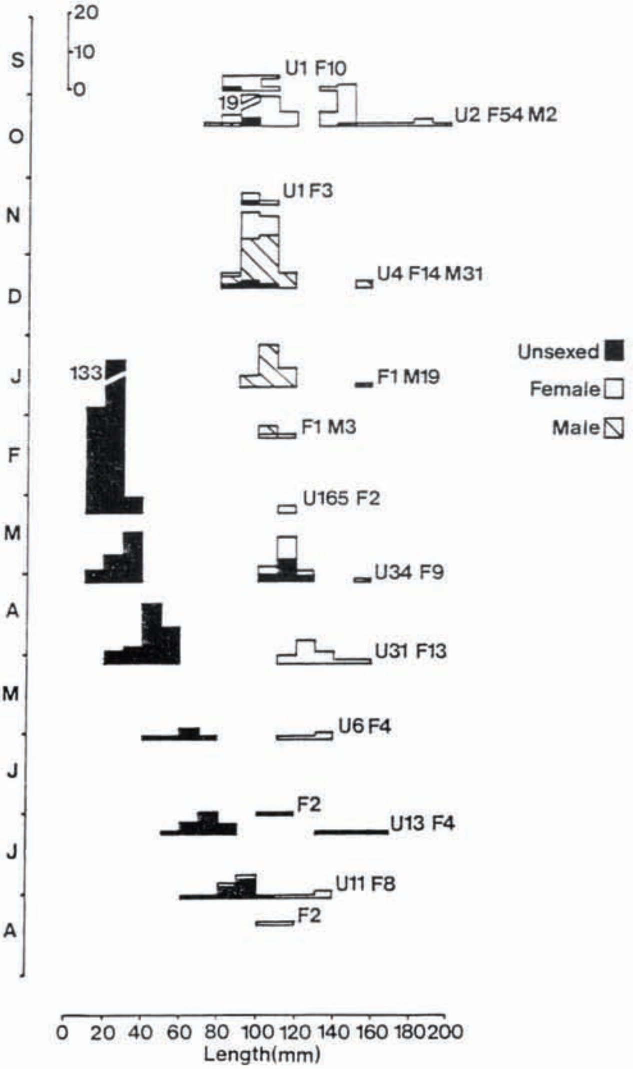

Fig. 2: Length frequency histogram of fish from Doha showing sex. U: unsexed; F: female; M: male; with numbers of each type.

gonads were determined to the nearest milligram. Whole otoliths were removed cleaned, dried and examined to determine age. The date of birth of any year class was assumed to be January 1st and the central opaque zone to correspond to the spring of the first year (Williams, 1986). These data were used to construct length frequency histograms and to calculate gonadosomatic indices (GSI's) where GSI = (W1/W2)*100 where W1 is gonad weight and W2 is total weight. Additional fish from a second hadra in Kuwait Bay at Kuwait City (29°,23'N 49°,58'E), (Fig. 1), were used in the calculation of GSI's.

RESULTS

Maximum temperatures (35.5°C) were recorded in August and the minimum (8.4°C) in January, maximum salinities (46‰) occurred in November and the minimum (40‰) in March.

A total of 448 fish were captured in the hadra and trawls at Doha and a further 239 fish from the Kuwait City hadra were included in the analysis of GSI's.

Young of the year recruited to the trawl catches during March 1988 at a modal length class of 20-30 mm (Fig. 2). In July small numbers of these fish were

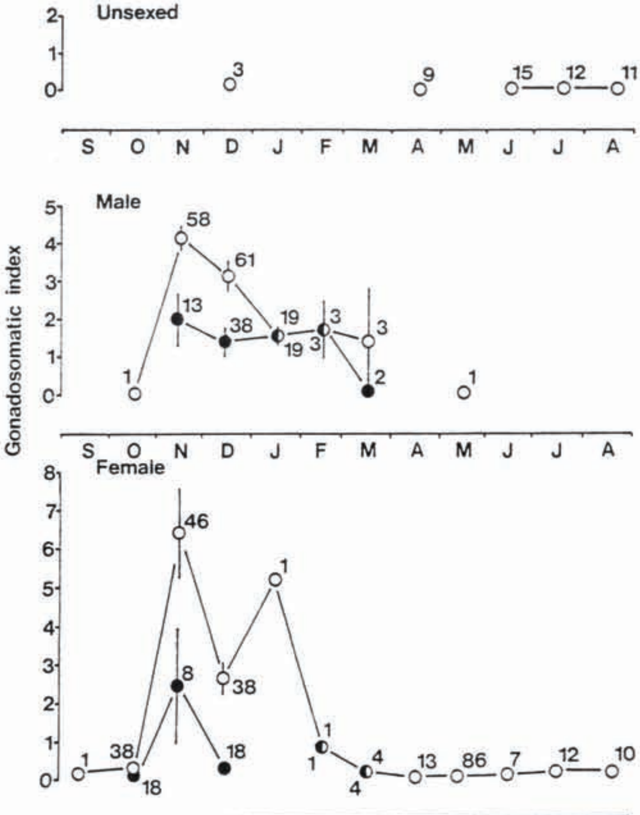

Fig. 3: Gonadosomatic indices for fish from Doha and Kuwait City with + 1 Standard Error; o all fish and •, fish in the first year of life.

first captured in the hadra. In September and October 1987, those fish in their first year of life that were approaching their first birthday were present at a modal length class of 90-100 mm and were captured mostly in the hadra. From November to February these fish were captured exclusively in the hadra. In March and subsequent months these fish, now in their second year of life, were captured mostly in the trawls. In October 1987, young of the year through to fish in their eighth year were captured in the hadra and trawls. The largest fish captured was of total length 194 mm.

Spawning, as shown by fish from Doha and Kuwait City, took place between November and March with a peak between November and December (Fig. 3). The length frequency distribution of fish captured at Doha shows that young of the year recruit during March and were captured entirely in the trawls (Fig. 2). These fish were of undetermined sex and were captured almost exclusively in the trawls until August. In August a small number were present with gonads dominated by ovarian tissue. Fish captured in September and October corresponded to fish recruited as young of the year in March of the preceeding year and were still in their first year of life. These fish contained gonads that mostly consist of ovarian tissue (Fig. 2, Table I). In December this size group of fish were approaching the end of their first year of life and a large proportion were present with gonads that consist mostly of testicular tissue. In January these fish had passed their first birth date and were now in the second year and were present entirely as fish with gonads consisting of testicular tissue. During February these fish were still present in small numbers but mostly as fish with gonads dominated by testicular tissue. Fish in their second year and older were either fish with gonads dominated by ovarian tissue or with regressed gonads of indeterminate sex. Three larger fish were captured that contained gonads dominated by testicular tissue (Table I).

Table I: Sex of *Diplodus sargus kotschyi* at various lengths for fish captured at Doha.

Length (mm)	Unsexed	Female	Male
10-19	31	0	0
20-29	143	0	0
30-39	21	0	0
40-49	16	0	0
50-59	11	0	0
60-69	7	0	0
70-79	8	1	0
80-89	8	7	3
90-99	10	33	14
100-109	4	22	25
110-119	6	18	10
120-129	2	9	0
130-139	0	13	0
140-149	0	12	1
150-159	0	5	2
160-169	0	2	0
170-179	0	1	0
180-189	0	2	0
190-199	0	1	0

DISCUSSION

Diplodus sargus kotschyi is closely associated with shallow sand and rock environments throughout its life (Relyea, 1981). Previous work in shallow muddy environments within Kuwait Bay reported very low catches (Wright, 1988). In South Africa juveniles of *D. sargus capensis* were closely associated with inshore reefs (Joubert, 1981). In Kuwait Bay they were not captured in beach seines suggesting these fish prefer slightly deeper water and are not found at the waters edge. This species is present in the intertidal zone and near sublittoral zone as young of the year through to adult spawning stock.

The present study confirms the observation that young of the year recruit during March (Dames and Moore, 1983). Spawning was considered to occur in February (Dames and Moore, 1983), however the present study shows that peak spawning takes place between November and March. The maximum total length captured was similar to that reported by Dames and Moore (1983) but was markedly smaller than reported by previous authors for fish in the Arabian Gulf (see Bauchot and Smith, 1984). This small size may reflect either a characteristic of the fish stock in Kuwait or is an indication of overfishing.

Studies on captive *Diplodus sargus* from the Mediterranean suggest that protandrous sex reversal occurred during and after the third year of life (Micale *et al.*, 1987). In the wild sex reversal is reported as occurring at a variety of ages (Atz, 1964). *D. sargus capensis* in South African inshore waters exhibits protandric hermaphroditism with functional females being larger than functional males, in small fish with ovo-testes the ovarian part of the gonad showed no seasonal development whilst the testicular development was complete (Coetzee, 1986). In the present study young of the year mature at the end of their first year and early in their second year predominantly as males although a smaller proportion were present as fish with gonads dominated by ovarian tissue. After spawning the spent males were left with resting ovarian tissue in the gonads and in their second year may mature either as females or males so that a small number of fish were present as males in their second year or older.

Diplodus sargus kotschyi is a winter spawning fish in the northern Arabian Gulf which shows unbalanced hermaphroditism (Micale *et al.*, 1987) with most fish being protandrous, reversal takes place in the second year of life. A number of fish never undergo sex reversal with many fish never developing testis and a small number remaining as males. The fish in Kuwait Bay have a markedly small maximum length.

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REFERENCES

ATZ J.W., 1964. - Intersexuality in fishes. *In*: Intersexuality in vertebrates including man (Armstrong C.N. & A.J. Marshall, eds), London: Academic Press: 145-232.

BAUCHOT M.L. & M.M. SMITH, 1984. - Sparidae. *In*: FAO species identification sheets for fishery purposes. Western Indian Ocean (Fishing Area 51). (Fischer W. & G.Bianchi, eds). Rome: Food and Agricultural Organisation.

BLEGVAD H., 1944. - Fishes of the Iranian Gulf. *Dan. Sci. Invest. Iran Part III:* 247 pp.

CLAYTON D.A. & F. ABOU-SEEDO, 1986. - Osteichthyes. *In*: A field guide to the sea shores of Kuwait and the Arabian Gulf. (Jones D.A., ed), Kuwait: University of Kuwait: 167-175.

COETZEE P.S., 1986. - Diet composition and breeding cycle of blacktail, *Diplodus sargus capensis* (Pisces: Sparidae), caught off St Croix Island, Algoa Bay, South Africa. *S. Afr. J. Zool.*, 21: 237-243.

DAMES & MOORE 1983. - Aquatic biology investigations. Studies for Sabiya area, Kuwait Bay and development of electrical networks, Vols 1 and 2, Ministry of Electricity and Water report, Government of Kuwait.

JONES D.A., 1986. - A field guide to the sea shores of Kuwait and the Arabian Gulf. Kuwait: University of Kuwait, 192 pp.

JONES D.A. & D.A. CLAYTON, 1983. - The systematics and ecology of crabs belonging to the genera *Cleistostoma* de Haan and *Paracleistostoma* de Maan on Kuwait mudflats. *Crustaceana*, 45: 183-199.

JOUBERT C.S.W., 1981. - Biology of five species of inshore reef fishes on the Natal Coast, South Africa. *Oceanogr. Res. Inst. (Durban) Invest. Rep.*, N° 51 : 1-16.

KURONUMA K. & Y. ABE, 1972. - Fishes of Kuwait. Kuwait: Kuwait Institute for Scientific Research: 123 pp.

KURONUMA K. & Y.ABE, 1986. - Fishes of the Arabian Gulf. Kuwait: Kuwait Institute for Scientific Research: 356 pp.

MICALE V., PERDICHIZZI F. & G. SANTANGELO, 1987. - The gonadal cycle of captive white bream, *Diplodus sargus* (L.). *J. Fish Biol.*, 31: 435-440.

RANDALL J.E., ALLEN G.R. & W.F. SMITH-VANIZ, 1978. - Illustrated Identification guide to commercial fishes. FAO. FI:DP/RAB/71/278/3. Rome: Food and Agricultural Organisation, 221 pp.

RELYEA K., 1981. - Inshore fishes of the Arabian Gulf. London: George Allen & Unwin, 149 pp.

WILLIAMS T.P., 1986. - Ageing manual for Kuwaiti fish, MB-44. Kuwait: Kuwait Institute for Scientific Research, 57 pp.

WRIGHT J.M., 1988. - Seasonal and spatial differences in the fish assemblage of the non-estuarine Sulaibikhat Bay, Kuwait. *Mar. Biol.*, 100: 13-20.

WRIGHT J.M., 1989. - Diel variation and seasonal consistency in the fish assemblage of the non-estuarine Sualibikhat Bay, Kuwait. *Mar. Biol.*, 102: 135-142.

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